

Claims

- [c1] 1. A method for recording analog signals and digitally encoded information associated with primary devices of an electric power system and secondary devices associated with the electric power system, the method comprising:
- receiving a plurality of analog output signals from corresponding transducers of the electric power system;
 - receiving a plurality of ON/OFF status signals from the primary and secondary devices of the electric power system;
 - receiving at least one of a time-synchronization analog signal from a time synchronization source and a time-synchronization data packet from the time synchronization source over a communication medium;
 - maintaining an internal clock synchronized with the synchronization source for time synchronization;
 - sampling and digitizing the analog output signals;
 - monitoring at least one of a status and a change of status of the ON/OFF status signals;
 - receiving digitally encoded information signals as data packets via a communication port;
 - decoding and analyzing the content of the incoming data

packets;

analyzing both the analog output signals and digitally encoded information signals using a user-programmable triggering mechanism; and

storing the incoming analog output and digitally encoded information signals together with corresponding timing information in a record as fault and sequence of events records in a non-volatile memory storage medium of a hosting device.

- [c2] 2. The method of claim 1, wherein at least one digitally encoded information signal related to at least one of the electric power system and the associated secondary equipment is recorded.
- [c3] 3. The method of claim 1, wherein the receiving digitally encoded information signals includes independently time tagging each incoming data packet for the record.
- [c4] 4. The method of claim 1, wherein reception of the digitally encoded information signals is recorded even if an incoming data packet is corrupted.
- [c5] 5. The method of claim 1, wherein copies of a same incoming data packet are recorded if at least one of a re-transmit and an auto-repeat scheme is in place.
- [c6] 6. The method of claim 1, wherein the incoming data

packets are encrypted packets recorded in their original encrypted form.

- [c7] 7. The method of claim 6, wherein the encrypted packets are deciphered from their original encrypted form in real-time and stored in a decrypted form.
- [c8] 8. The method of claim 1, wherein auxiliary information contained in the data packet includes at least one of CRC and sequence numbers and is stored as a part of the record.
- [c9] 9. The method of claim 1, wherein time-synchronization data packets facilitating the time synchronization over the communication medium are time tagged and recorded.
- [c10] 10. The method of claim 1, wherein existence and configuration of devices producing the digitally encoded information signals to be recorded is recognized automatically based on a self-description mechanism if supported by an applied communication protocol.
- [c11] 11. The method of claim 1, wherein a health status of the communication medium used to transport a content of the digitally encoded information signals is monitored via at least one of a hardware and software means, and detected problems are time tagged and recorded as a

part of the record.

- [c12] 12. The method of claim 1, wherein a percentage usage of the communication medium used to transport the digitally encoded information signals is monitored via at least one of hardware and software means, and recorded as a part of the record.
- [c13] 13. The method of claim 1, wherein the digitally encoded information signals are received via a wireless port.
- [c14] 14. The method of claim 13, wherein a health status of the wireless communication medium used to transport a content of the digitally encoded information signals is monitored via at least one of a hardware and software means, and detected problems are time tagged and recorded as a part of the record.
- [c15] 15. The method of claim 1, wherein a health status of the corresponding analog transducer is recorded with the analog output signal of the corresponding transducer.
- [c16] 16. The method of claim 1, wherein the time synchronization of the internal clock is achieved based on the incoming data packets instead of a dedicated time synchronization analog signal.

- [c17] 17. The method of claim 16, wherein the incoming packets used to synchronize the internal clock share a communication port with the monitored incoming data packets.
- [c18] 18. The method of claim 1, wherein the memory storage medium is removable without disassembling the hosting device in which it is employed.
- [c19] 19. The method of claim 18, wherein the record of the memory storage medium is preserved for access through a separate reading device.
- [c20] 20. The method of claim 18, in which the memory storage medium is removable and insertable with the hosting device being powered on.
- [c21] 21. The method of claim 18, wherein the removable memory medium comprises of two or more independent storage units.
- [c22] 22. The method of claim 18, wherein a recording function of the hosting device are retained during removal and insertion of the removable memory medium.
- [c23] 23. The method of claim 18, wherein the memory medium has no part thereof movable relative to any other part thereof.

- [c24] 24. The method of claim 18, wherein the removable memory medium is encrypted and readable only after providing appropriate security information.
- [c25] 25. The method of claim 18, wherein the removable memory medium is internally tested upon insertion and before use thereof.
- [c26] 26. The method of claim 1, wherein a configuration of the hosting device and stored records are protected from cyber attacks by authentication procedures that utilize wireless access.
- [c27] 27. The method of claim 26, wherein the authentication is performed with a proximity card, the proximity card absent electrical wires and an internal power source.
- [c28] 28. The method of claim 1, wherein a configuration of the hosting device is changed with a proximity card, the proximity card absent electrical wires an internal power source.
- [c29] 29. The method of claim 1, wherein the hosting device is controlled wirelessly for at least one of configuration changes, record management, and other supported functions.
- [c30] 30. The method of claim 1, wherein a number of self-

tests are performed continuously or periodically in order to monitor integrity of the hosting device.

- [c31] 31. The method of claim 30, wherein the hosting device is configured to report internal problems absent a power supply connected therewith.
- [c32] 32. The method of claim 1, wherein the device is capable of initiating communication with one of a higher order system and a device based on pre-defined conditions, the pre-defined conditions include at least one of high memory utilization and self-test error.
- [c33] 33. The method of claim 1, wherein the hosting device is configured to retrieve the record and change a configuration of the hosting device via at least one of public, proprietary SCADA, and substation integration protocols.
- [c34] 34. The method of claim 1, wherein a storing rate for both the analog and digitally encoded information signals is different for different channels corresponding to different physical inputs and different communication ports.
- [c35] 35. The method of claim 1, wherein a storing rate for both the analog and digitally encoded signals is dynamic and controlled via user-definable conditions.

- [c36] 36. The method of claim 1, wherein the hosting device simultaneously supports a multitude of communication protocols for the digitally encoded information signals over a single or multiple communication ports.
- [c37] 37. The method of claim 1, wherein the hosting device supports primary and secondary communication ports.
- [c38] 38. The method of claim 37, further comprising recording the digitally encoded signals separately for the primary and secondary ports.
- [c39] 39. The method of claim 1, further comprising creating separate records for various groups of the digitally encoded signals based on a logical organization of the communication medium.
- [c40] 40. The method of claim 1, further comprising sending and receiving a test message intended to monitor at least one of integrity and quality of the communication medium.
- [c41] 41. The method of claim 40, wherein one of the primary and secondary devices sends and another echoes back the test message, wherein comparison of the sent and echoed messages allows monitoring parameters of the communication medium.

[c42] 42. The method of claim 1, further comprising recording and overlaying with at least one of power system signals, selected video and audio signals available as digital packets, and signals related to monitoring electric power system.

[c43] 43. An apparatus for recording analog signals and digitally encoded information associated with primary devices of an electric power system and secondary devices associated with the electric power system, the apparatus comprising:

a hosting device configured for:

receiving a plurality of analog output signals from corresponding transducers of the electric power system;

receiving a plurality of ON/OFF status signals from the primary and secondary devices of the electric power system;

receiving at least one of a time-synchronization analog signal from a time synchronization source and a time-synchronization data packet from the time synchronization source over a communication medium;

maintaining an internal clock synchronized with the synchronization source for time synchronization;

sampling and digitizing the analog output signals;

monitoring at least one of a status and a change of status of the ON/OFF status signals;

receiving digitally encoded information signals as data packets via a communication port;
decoding and analyzing the content of the incoming data packets;
analyzing both the analog output signals and digitally encoded information signals using a user-programmable triggering mechanism; and
a non-volatile memory storage medium in operable communication with the hosting device, the non-volatile memory storage medium storing the incoming analog output and digitally encoded information signals together with corresponding timing information in a record as fault and sequence of events records.